ICT AND ECONOMIC GROWTH IN EIGHT ISLAMIC DEVLOPING COUNTRIES (D8)

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Abstract

Economic growth theories predict that economic growth is driven by investments in Information and Communication Technology (ICT). Empirical studies of this prediction have produced mixed results, depending on the research methodology employed and the geographical configuration considered. To provide yet a further test, this paper used panel data approach and applies it to the economy of D8 Group member countries (Iran, Turkey, Egypt, Nigeria, Bangladesh, Pakistan, Malaysia, Indonesia) over the time span of 1990-2009. The estimates reveal a significant impact on economic growth of investments in ICT in the D8 member countries. This implies that if these countries seek to enhance their economic growth, they need to implement specific policies that facilitate investment in ICT.

Keywords: ICT, D8 Group, Economic Growth, Panel Data

1. Introduction

The objective of this study is to explore the impacts of ICT investment on economic growth in a cross section of 8 Islamic countries using the data over the period 2000-2009. Panel data analysis is carried out to examine the factors affecting economic growth. To understand the current state of ICT and macroeconomic situation of 8 Islamic countries, a comprehensive review of pertinent statistics related to ICT and economic growth is examined to find common stylized facts in the economies.

ICT in D8 have for several decades been called on to support the transfer of business practice that has been considered to be effective in the successfully competitive economies. Some recent theoretical and empirical literature studies the positive effect of ICT on productivity (Jorgenson & Stiroh (1995)), Mansell & When (1998), Pohjola (2000 and 2001) and Haacker & Morsink (2002). On the other hand some other recent empirical literature shows the potential negative impact of ICT on economic growth especially for the developing countries (Dewan &Kraemer (2001), Ambert & Chapelle (2003), and Satti & Nour (2002). The majority of these studies are based on the debate that technical changes are creative destruction. ICT has some positive impacts to enhance economic development; however in the other hand it has some negative impacts on some dimensions of economic development. Hence some studies Aghion and Howitt (1998), Freeman and Soete (1985), Freeman and Soete (1994) and Freeman and Soete (1997) discuss the negative impacts of ICT on employment and labor market in particular the unemployment effect. In addition, that ICT could create some negative impacts for growth and convergence of developing countries. In fact the developed countries will have some more competitive advantages raising their domination on global world. Developing countries will be not only less competitive in the international market, but also will be threatened in their original local markets. ICT might also create some negative impacts in the income distribution within the developing countries.

2. ICT and Economic Growth: Empirical Studies

Recently, some studies have analyzed the relationship between ICT and economic performance. Many of them examined the impact of ICT on productivity growth. However, the main conclusion of most studies supported the positive impact of ICT on economic performances of developed as compared to developing countries. For example, Jorgenson and Vu (2005) found that the contribution of ICT capital to world GDP had more than doubled and now accounts for 0.53 per cent of the world average GDP growth of3.45 per cent. The percentage was higher for the group of G7 countries, where ICT investments contributed with 0.69 per cent to a GDP growth of 2.56 per cent during 1995–2003. Oulton and Srinivasan (2005) used a new industry-level dataset to quantify the role of ICT in explaining productivity growth in the UK, 1970-2000.

The dataset is for 34 industries covering the whole economy (31 in the market sector). Using growth accounting they found that ICT capital played an increasingly important, and in the 1990s the dominant, role in accounting for labor productivity growth in the market sector. Econometric evidence also supports an important role for ICT. They also found econometric evidence that a boom in complementary investment in the1990s could have led to a decline in the conventional measure of TFP growth. Ketteni (2006) has shown that total ICT capital has a nonlinear effect on total factor productivity growth. Youngsang Cho, Jongsu Lee and Tai-Yoo Kim (2007) investigated the effects of information and communications technology (ICT) investment, electricity price, and oil price on the consumption of electricity in South Korea's industries using a logistic growth model. They found that ICT investment reduces electricity consumption in only one manufacturing sector and that it increases electricity consumption in other five sectors including service sector in South Korea. Ketteni and cooperators (2007) have examined the Information and Communication Technology (ICT) capital-economic growth nexus, taking into consideration the previously documented nonlinear relationship between initial income and human capital on the one hand and economic growth on the other. They applied nonparametric techniques for a number of OECD countries for the period 1980–2004. Rim Ben Ayed Mouelhi (2009) aimed at measuring the impact of information and communication technology use on the efficiency of the Tunisian manufacturing sector at the firm level within a simple theoretical framework. They used a firm-level panel data for the manufacturing sector in Tunisia to investigate whether adoption of ICT influences efficiency in factor use. The analysis is conducted through the use of a parametric method to measure technical efficiency. They estimated a stochastic production frontier and the relationship aims to explained technical efficiency differentials in a single stage as suggested by Battese and Coelli Battesse, G.E, Coelli, T.J. (1995). A model for technical inefficiency in a stochastic frontier production functions for panel data.

Khuong M. Vu (2011) examines the hypothesis that ICT penetration has positive effects on economic growth. This paper conducts three empirical exercises to provide a comprehensive documentation of the role of ICT as a source of growth in the 1996–2005 period. The first exercise shows that growth in 1996–2005 improved relative to the previous two decades and experienced a very significant structural change. Sophia P. Dimelis and Sotiris K. Papaioannou (2010) have studied on the growth impact of Information and Communication Technologies using industry-level data for the US and the EU industries over the period 1980–2000. A panel data approach was employed to estimate the ICT effect using the system GMM and the pooled mean group panel data estimators. The GMM estimates suggested a significant ICT effect on growth during the 90s both in the US and in the EU. This effect for the EU was strong in the early 90s and weakened afterwards, as opposed to the US where it strengthened in the late 90s. Diego Martínez, Jesús Rodríguez and José L. Torres(2010) studied the impact of information and communication technologies (ICT) on US economic growth using a dynamic general equilibrium approach. A production function with six different capital inputs was used, three of them corresponding to ICT assets and the other three to non-ICT assets. The technological

change embedded in hardware equipment was found to be the main leading non-neutral force in US productivity growth, accounting for about one quarter of total growth during the period 1980–2004. Hwan-Joo Seo, Young Soo Lee and Jeong Hun Oh (2009) built a model of cumulative growth to examine the dynamic interdependent relationship between ICT investment and economic growth for a sample of 29 countries in the 1990s. They confirmed the following facts: First, there is a positive correlation between ICT investment and economic growth. Second, non-ICT investment has as much influence on the growth gap as ICT investment. Third, those countries with a solid economic infrastructure and open trade regime experience more active ICT investments. Fourth, those countries with a comparatively lower productivity level can reduce the gap using knowledge spillovers from more advanced countries. Fifth, reinforcement of patent rights has a positive influence on economic growth by stimulating the accumulation of ICT capital. Finally, ICT investment does not have a strong interdependent relationship with economic growth, while non-ICT investment has a cumulative causal relationship with economic growth and plays a key role in the process of widening the growth gap.

3. Theory and calculation

3.1 The Model

The following captures the general framework of growth models with ICT as an explanatory variable:

$$Y_t = Y(Y_t^{ICT}, Y_t^{0}) = A_t F(C_t, K_t, N_t) \tag{1}$$

Where t is time in all cases, Y is the total added value, Y_t^{ICT} YICT is added value of goods and services related to ICT, and Y_0 represents the value added related to other products. Production is possible through ICT inputs (C) and non-ICT inputs: physical capital (K) and labor force (N).

ICT influences economic growth, production and productivity in three basic ways. First ICT's goods and services (Y_t^{ICT}) are a part of the value added of the economy. Second, utilizing ICT capital, or C used as an input in the production of all goods and services will lead to economic growth. Finally ICT can cause economic growth through its contributions to technological change. If the growth of ICT's production is based on the benefits of efficiency and productivity in the activities, it will lead to an increase in productivity growth at the macro-economic level (Pahjola, 2002).

There are two different approaches to estimating the effect of ICT investments on economic growth: "the production function approach" and "the growth accounting approach".

The following generalized form of the Cobb Douglas production represents the production function approach:

$$Y = Af[L,K,ICT] = AL^{\alpha}K^{\beta}ICT^{(1-\alpha-\beta)} \qquad (2)$$

Where the subscript t standing for time has been eliminated to simplify the presentation. Conversion to logarithm yields the following in log-linear form:

$$LNY=\beta_0+\beta_1 LNL+\beta_2 LNK+\beta_3 LNICT + \varepsilon \qquad (3)$$

This relationship can be estimated using time-series within a country or cross section data across countries. Assuming constant returns to scale, and each factor receiving its marginal product

3.2. The Empirical Model

In his paper, we choose to work with the production function approach; because it was more widely used in economics and it had less restrictive assumptions. Specifically the following simple double log

Cobb-Douglass production was the equation used in our regression:

$$LnGDP_{it} = c + \alpha_1 LnK_{it} + \alpha_2 LnICT_{it} + \alpha_3 LnL_{it} + \alpha_4 LnFDI_{it} + \alpha_5 LnOPN_{IT} + U_{it} \qquad (4)$$

where: α_0 is a constant coefficient, $LnGDP_{it}$ is natural logarithm of real GDP per capita in constant 2000 prices in US dollar, $LnICT_{it}$ is natural logarithm of investment in ICT, LnK_{it} is natural logarithm of gross domestic investment, LnL_{it} is log of total labor force , $LnOPEN_{IT}$ is an index that indicator degree of openness of the economy's growth rate dividing the total value of exports and imports over GDP. $LnFDI_{it}$ Is foreign direct investment as an indicator of technical and technological improvement. U_{it} is the model's random error component.

3.3. The Data

The data mainly were based on the World Bank (2010), world development indicator (WDI). The time period under The Data on foreign direct investment were compiled from the statistical resources published by the World Bank.

The data on ICT includes:

(a) Computer hardware (computers, accessories and enhancements)

(b) Software (agent systems, programming means, etc)

(c) Computer services (IT devices, etc) and communication services

(d) Wire and wireless communication equipment.

we took the ICT/GDP ratio from the World Bank's statistical Information. We applied the ratio to the data on real (2000 constant prices) GDP series available in various D8 member countries and arrived at the ICT series for these countries. Gross Capital Formation (or Gross Domestic Investment) includes expenditures on fixed assets (land and land improvement, plant, machinery and equipment, road and rail transportation, school, administrative, hospitals, and industrial and business buildings) plus net changes in inventories. The change in inventories also comprises investments in the form of goods held in stocks to deal with temporary unexpected fluctuations (World Bank, 2010).

The table1 shows variable that used in model:

Table1: variable and source of variable

Variable name	Variable description	Source	Time coverage
LNGDP	Log of gross domestic product	WDI	2000-2009
LNFDI	Log of foreign direct investment in flow	WDI	2000-2009
LNL	Log total employment	WDI	2000-2009
LNK	Log domestic investment	WDI	2000-2009
LNICT	Log ICT/GDP	WDI	2000-2009
LNOPEN	Value of exports and imports over GDP	WDI	2000-2009

4. Results and Discussions

Our findings based on the fixed-effects and random-effects models are summarized in Tables Broadly, the results of both models confirm the expected relationship between the Gross Domestic Product on the one hand and ICT and other variables on the other. In both models, the variables representing the sources of growth have the expected signs. Since the models estimated were in logarithmic forms, all estimated coefficients represent elasticities.

In general a regression model of panel data is as follow:

$H_0 : \beta_0 = \beta_1 = ... = \beta_n$

$H_1 : \beta_i \neq \beta_j$

Where $E(U_i) = 0$ and have constant variance. μ_i Include fixed effects that show difference between individual, households or countries especial characteristic. v_{it} is residual term that: $v_{it} \approx IND(0, \delta_7^4)$ First we test heterogeneous between units by F-statistic. If null hypothesis isn't accepted, we use panel data. Null hypothesis is:

$$F(n-1, nt-n-k) = \frac{(RSS_{UR} - RSS_{R})/(n-1)}{(1-RSS_{UR})/(nt-n-k)}$$

RRSS: Restrict Residual sum Squares
URSS: Unrestricted Residual sum Squares
N=numbers of units
K=numbers of parameters
table 2 shows the coefficient of F-test statistics with 7.47 degree of freedom is equal to the number 17.830563 positive and statistically meaningful at the probability level of more than 99 percent.

Table2: Choosing Between Panel Data & OLS (Using F-Test)

Possibility	Degree of freedom	Statistic
0.0000	7.47	17.830563

Table 3 shows Hausman test for choice between Fixed Effect (F.E) and Random Effect (R.E) models. Generally accepted way of choosing between fixed and random effects is running a Hausman test. In Hausman test null hypothesis show Fixed Effect. In according above tests we run the regression whit random effect model (EGLS method).The coefficient of Hausman test statistics is equal to the number 101.131045 positive and statistically meaningful at the probability level of more than 95 percent. This means that Null hypothesis is rejected and we conclude that the best way to estimate the fixed effects.

Table3: Choosing Between Fixed and Random Effects (Using Hausman test)

Possibility	Degree of freedom	Statistic $\chi 2$
0.0000	5	101.131045

Statistically, fixed effects are always a reasonable thing to do with panel data (they always give consistent results) but they may not be the most efficient model to run. Random effects will give us better P-values as they are a more efficient estimator, so we should run random effects if it is statistically justifiable to do so.

Table4: The effect of ICT investment on economic growth in the D8 member countries

Dependent variable: Log of GDP						
		Model estimation methods fixed effects			Model estimation methods random effects	
Explanatory variables	coefficients	Statistic *t*	Possibility	coefficients	Statistic t	Possibility
Constant factor	-40.80027	-4.354801	0.0001	4.411344	2.207929	0.0315

Total labor force	2.397376	4.594864	0.0000	0.223463	3.246164	0.0020
Gross domestic capital formation	0.871937	4.349334	0.0001	0.027252	3.785323	0.0004
Investment in ICT	0.629542	10.025721	0.0485	0.183977	2.365276	0.0216
Technical and technological development(FDI)	0.047278	1.724493	0.0912	0.209413	10.97333	0.0000
Degree of economic openness	-0.274671	-1.643813	0.1069	-0.609772	-8.213485	0.0000
R-Squared		0.960316			0.974168	
Adjusted *R-Squared*		0.950185			0.971776	
F-statistic		94.78089		0.0000	407.2804	0.00000

Table 4 shows the effect of ICT investment on economic growth in D8 member countries. Investment in ICT, gross domestic investment, human capital and direct foreign investment show a positive effect while Degree of economic openness show a negative effect on economic growth of D8 member countries.

Since ICT plays such a vital role in economic growth, there is no doubt, that government takes great part in promoting the awareness of the benefits associated with the use of ICT, but it is imperative to set up some independent bodies that would be actively involved in monitoring ICT performance in the economy, and make suggestions on improvements. The coefficient of ICT investment is positive and statistically meaningful at the probability level of more than 95 percent. Since all variables are in logarithm, the value of 0.62 for the ICT coefficient means that the elasticity of economic growth within the D8 member countries is actually 0.62 implying that a one percent increases in ICT investment would lead to a 62 percent economic growth in these countries. The gross domestic investment (K) coefficient in the estimated model is 0.87 and statistically meaningful at the probability level of more than 99 percent which implies that non-ICT investments also had a positive and meaningful effect on economic growth of the D8 member countries. The foreign Direct Investment (FDI) coefficient that is an indicator of the technical and technological indices of the model is positive, equal to 0.047 and acceptable at about 95 percent confidence level.

The sign of Total employment is positive and statistically meaningful at the probability level of more than 99 percent. It appears that in spite of some improvements in labor force in the D8 member countries. it is still necessary for businesses to think of ways of consolidating the trend, the maximize the benefits brought by the use of this technology. This could be achieved through regular technical optimization with the prime quest for speed, security and multifunction. Moreover, a dynamic management with strong development focuses. It is also worth noting that flexibility in international trade laws is predominant in ensuring that businesses are able to

import ICT goods of their choice and specification, from different parts of the world. The sign of Degree of economic openness is negative but it is not meaningful fixed effects.

Does the speed of ICT development affect the speed of economic growth? It is possible to say that if recent ICT developments have contributed enormously to economic growth in a short amount of time, in economic terms, then, there seems to be a positive correlation between the two. Hence, R&D in ICT must be encouraged and measured against the needs and demands of the market.

5. Summery and Conclusions

This paper concentrated on exploring effect of ICT on economic growth in the D8 member countries. ICT in D8 have for several decades been called on to support the transfer of business practice that has been considered to be effective in the successfully competitive economies, such as business process re-engineering, integrated enterprise information infrastructures, or customer relationship management systems. More recently, they have been channeling their professional skills into e-government projects, which have involved them in intervening in the explicitly political setting of government administration. There is a widespread expectation that government can be transformed into a network of rationalized institutions, as seen desirable from a contextual view of economic development. There results of the growth model estimations with ICT as an explanatory variable using Panel Data method in the context of the D8 member countries show that ICT has a meaningful effect on the economic growth of these countries. The coefficient measuring the effect of the ICT gross domestic investment on economic growth was positive, indicating that ICT investments affect economic growth of the D8 member countries in a positive way. Direct foreign investment coefficient, which is the technical and technological index of the model, is positive and meaningful at the probability level of about 95 percent. This shows that direct foreign investment growth has a positive effect on the economic growth of D8 member countries. The D8 member countries were left with the alternative of using their internal resources for investment to keep production and job creation. The positive and meaningful coefficient of gross domestic investment in the estimated model points to the direction of this argument.

Another variable is the degree of economic openness that has a negative but it is not meaningful effect in D8 member countries.

Since ICT can play a vital role as a mean for economic growth, it becomes necessary for the D8 member countries to encourage the utilization of ICT in order to boost economic growth. From the results presented in this paper some tentative conclusions can be drawn. The D8 member countries cannot get the full benefits of ICT unless they have the social and cultural Infra-structures and skills required for utilizing ICT's capabilities. It is essential for governments to provide the society with information and on-time services and to educate people on how to use ICT. They should encourage institutions, which are active in the field of ICT. Since direct foreign investment is a technological variable of the model and has a positive effect on economic growth, it is crucial for D8 member countries and to be more active in attracting direct foreign

investment. To fill the gap that exists between D8 member countries and the leading countries in the field of ICT development, it is essential to allocate and ensure necessary financial resources for investing in network infrastructures and technology with the aim of providing new potentials in D8 member countries.

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